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HELIUM RESEARCH CENTER
INTERNAL REPORT

PRESSURE MEASUREMENT WITH RUSKA INSTRUMENT CORPORATION PISTON GAGE,

SERIAL NO. 9274

BY

Ted C. Briggs

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SERIAL NO. 9274

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Amarillo, Texas

Work on manuscript completed November 1964

PRESSURE MEASUREMENT WITH RUSKA INSTRUMENT CORPORATION PISTON GAGE,
SERIAL NO. 9274

by

Ted C. Briggs^{1/}

ABSTRACT

This report contains calibration data for Ruska Instrument Corporation piston gage No. 9274, and test data for Ruska Instrument Corporation differential pressure cell No. 9032. The report contains tables to facilitate calculation of a gage pressure. A sample calculation is included in the report.

INTRODUCTION

The precise measurement of a pressure with a piston gage requires calibration data for the instrument, corrections for the instrument variables, and corrections for the influence of the surrounding environment upon the measured pressure. This report contains calibration data, tables of correction factors, and equations applicable to Ruska Instrument Corporation piston gage No. 9274. The report is a supplement to the operating instructions for the gage.

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Ruska piston gage No. 9274 is presently being used to make precise pressure measurements of gases at high pressures. Measurement of gas pressure with an oil piston gage requires separation of the oil from the gas. This separation is achieved by Ruska Instrument Corporation differential pressure cell, serial No. 9032. The measured pressure is influenced by the characteristics of the differential pressure cell; therefore, calibration data for differential pressure cell No. 9032 is included in the report.

For general discussions of pressure measurement with a piston gage refer to National Bureau of Standards Monograph 65^{2/}, and Ruska static

2/ J. L. Cross. "Reduction of Data for Piston Gage Pressure Measurements." National Bureau of Standards Monograph 65, June 17, 1963.

pressure measurement manual^{3/}.

3/ "Static Pressure Measurement Laboratory Manual." Ruska Instrument Corporation, Houston, Texas.

Pressure Measurement with Piston Gage No. 9274

The general equation for calculation of a gage pressure is equation (1).

$$P = \frac{M_a (1 - \rho_a / \rho_b) g_1 / g_s}{A_o (1 + bP) [1 + c (t - 25)]} \quad (1)$$

The terms in equation (1) are:

P = gage pressure, psig

M_a = apparent mass, of the load on the piston, in air against
brass standards, lbs

ρ_a = density of air, gms/cm³

ρ_b = density of brass, gms/cm³

g_1 = numerical value for the acceleration of gravity at the gage
location, gals

g_s = numerical value for the standard acceleration of gravity, gals

A_o = effective piston area at 25° C and zero pressure, in²

b = fractional change in the effective piston area due to
elastic distortion, psi⁻¹

c = coefficient of superficial expansion for the piston and
cylinder, °C⁻¹

Piston gage No. 9274 was calibrated at the Ruska Instrument Corporation plant on February 22, 1962. The gage was calibrated by comparison against Ruska Instrument Corporation laboratory master gage No. 7544. Ruska gage No. 7544 was tested by the National Bureau of Standards, and the piston area of gage No. 7544 is reported to be correct to one part in 10,000 at 25° C. Calibration data supplied by Ruska Instrument Corporation is recorded in table 1.

The weights for gage No. 9274 are of 303 stainless steel with a density of 7.8 grams/cm³. The apparent mass of the weights in air was determined at the Ruska Instrument Corporation plant on February 27, 1962, by comparison against National Bureau of Standards certified

weights. The piston gage weight calibration data is recorded in table 2. Table 3 is a weight summation table obtained from the data in table 2. The weight summations are obtained by adding the weights in alphabetical sequence.

To convert from pounds mass to pounds force the apparent mass M_a is multiplied by the ratio of the local acceleration of gravity g_1 to the standard accelerations of gravity g_s . A value of 979.4091 gals^{4/} is used for the acceleration of gravity at the piston gage

^{4/} B. J. Dalton. "Local Value of Acceleration of Gravity at the Helium Research Center." Memorandum Report No. 43, Helium Research Center, April 1964.

location. Standard acceleration of gravity is 980.665 gals. The ratio g_1/g_s in equation (1) is 0.9987193.

To simplify the calculation of a measured pressure a table of values of $\frac{M_a g_1/g_s}{A_o}$ was compiled. The values are listed in table 4, and are weight summations of table 3 multiplied by the gravity ratio and divided by the zero pressure effective piston area at 25° C.

A correction must be applied for the buoyant effect of air upon the piston gage weights. The buoyancy correction is the factor $(1 - \rho_a/\rho_b)$ in equation (1). The density of air ρ_a is a function of the barometric pressure, the temperature, and the relative humidity; therefore, the density correction can vary for each measured gage pressure. A table of density of dry air as a function of barometric

pressure and of temperature was computed from equation (2) reference^{5/}.

$$\rho_a = 1.2932 \frac{T}{T_0} P [1 - 0.000602(P - 1) - 0.0000105tP] \quad (2)$$

5/ R. E. Barieau. "The Density of Moist Air from 0° to Near 25° C and Near Atmospheric Pressure." Internal Report No. 36, Helium Research Center, August 1963, page 14.

The terms in equation (2) are:

ρ_a = density of dry air, gms/liter

T_0 = absolute temperature at the ice point

T = absolute temperature

P = pressure, atm

t = temperature, °C

Numerical values of the density of dry air in grams/liter were recorded in table 5. Table 6 is a table of buoyancy correction factors $(1 - \rho_a/\rho_b)$ for dry air computed from the values in table 5 and a density of brass of 8.4 grams/cm³.

Ruska Instrument Corporation piston gage 9274 has a re-entrant type cylinder, and the effective piston area decreases with increasing pressure. A correction must be applied for the change of effective area with pressure. The distortion correction is the term $\frac{1}{1 + bP}$ in equation (1). From table 1 $b = -3.5 \times 10^{-8} \text{ psi}^{-1}$. Values of $\frac{1}{1 + bP}$ for various pressures are recorded in table 7.

The effective piston area is a function of the gage temperature.

The factor $\frac{1}{1 + c (t - 25)}$ in equation (1) corrects the gage pressure for piston temperatures other than 25° C. Table 8 is a table of temperature correction factors, $\frac{1}{1 + c (t - 25)}$.

The measured pressure must be corrected for the zero shift of the differential pressure indicator with pressure. Ruska Instrument Corporation differential pressure cell and indicator, serial No. 9032, were repaired and recalibrated at the Ruska Instrument Corporation plant in June 1964. The zero shift of indicator No. 9032 is given by equation (3).

$$\Delta P = 1.85 \times 10^{-6} P \quad (3)$$

The quantity ΔP is added to the measured gage pressure to give the corrected gage pressure. The units of P and ΔP in equation (3) are psi. Table 9 is a table of corrections for the zero shift with pressure for differential pressure cell No. 9032.

Oil Head Correction

Consideration must be given to the possibility of a pressure correction due to the force exerted by a column of oil in the measuring system.

Brass blocks, machined in the Machine Shop, were placed under the piston gage to raise the piston gage reference plane level to the level of the diaphragm in the differential pressure cell. At present the level of the diaphragm in the differential pressure cell coincides closely to the level of the reference plane of the piston gage. The oil head correction in the present system arrangement is negligible.

Sample Calculation of a Gage Pressure

Suppose one wishes to measure a gas pressure with piston gage No. 9274. Assume the differential pressure meter indicates the null position when weights A, B, C, D, M, O, P, Q, U, W, X, \bar{A} , \bar{C} , \bar{D} , \bar{E} , \bar{G} , \bar{H} , + Tare are on the piston gage. The nominal pressure on the gage would be $4373.783 + 30$ psig. From table 4 obtain a corrected pressure of $4367.8341 + 29.9590 = 4397.7931$ psig. It should be noted that to obtain the correct pressure from table 4 the weights must be loaded on the gage in sequence, and the tare pressure must be added separately to the pressure due to other weights on the gage. Assume that the corrected barometer reading was 667.35 mm of mercury, and the room temperature was 24.6° C at the time the piston gage balance was obtained. Interpolate between increments in table 6 and obtain a buoyancy correction factor $(1 - \rho_a / \rho_b)$ of 0.9998761. Multiply the corrected gage pressure 4397.7931 psig by the buoyancy correction factor and obtain the pressure 4397.2482 psig. From table 7 obtain the pressure distortion correction factor $\frac{1}{1 + bP}$ of 1.0001539. Suppose the piston gage temperature was 27.3° C at the time of pressure balance. From table 8 obtain the temperature correction factor $\frac{1}{1 + c(t - 25)}$ of 0.9999609. From table 9 obtain the correction 0.0081 psi to be added to the gage pressure to correct for the zero shift with pressure of differential pressure cell No. 9032. Add the null indicator correction to the gage pressure corrected for air buoyancy, and multiply by the distortion and temperature corrections to obtain the gage pressure 4397.7611 psig. Since the piston gage can be balanced to only the nearest 0.001

psi at best, the final reported gage pressure should be rounded to 4397.761 psig. To obtain the measured pressure in psia the atmospheric pressure must, of course, be added to the gage pressure.

TABLE 1. - Ruska Instrument Corporation calibration data for piston gage No. 9274

Range.	30 to 12,140 psi
A_o	0.0260416 in ²
b.	- 3.5 x 10 ⁻⁸ /psi
c.	1.7 x 10 ⁻⁵ /°C
Piston material.	Tungsten Carbide
Cylinder material.	A.I.S.I. Type A6
Type cylinder.	Re-entrant
Tare (apparent mass)	0.78118 lb
Resolution*.	< 5 ppm
Leak rate.	0.02 in/min for Teresstic #38 oil
Plane of reference	0.07 in. below line on sleeve weight

* Minimum resolution at all calibrating test points

TABLE 2. - Ruska Instrument Corporation weight calibration data for piston gage No. 9274

<u>Designation</u>	<u>Nominal pressure, psi</u>	<u>Apparent mass against brass M_a, lbs</u>
High tare	30	0.78118
A 1	1000	26.03950
B 2	1000	26.03943
C 3	1000	26.03961
D 4	1000	26.03954
E 5	1000	26.03954
F 6	1000	26.03961
G 7	1000	26.03961
H 8	1000	26.03961
I 9	1000	26.03967
J 10	1000	26.03956
K 11	1000	26.03963
L 12	500	13.01975
M 13	200	5.20789
N 14	200	5.20791
O 15	100	2.60401
P 16	50	1.30197
Q 17	20	0.52079
R 18	20	0.52080
S 19	10	0.26039
T 20	5	0.13019
U 21	2	0.05208
V 22	2	0.05208
W 23	1	0.02604
X 24	0.5	0.01302
Y 25	0.2	0.00521
Z 26	0.2	0.00521
AA 27	0.1	0.00260
AB 28	0.05	0.00130
AC 29	0.02	0.00052
AD 30	0.02	0.00052
AE 31	0.01	0.00026
AF 32	0.005	0.00013
AG 33	0.002	0.00005
AH 34	0.002	0.00005
AI 35	0.001	0.00003
High range piston		0.05776
High range table		0.72342

TABLE 3. - Weight summation table for piston gage No. 9274

Nominal pressure, psi	M _a , lbs	Nominal pressure, psi	M _a , lbs
12,000	312.47487		
11,000	286.43531		
10,000	260.39568		
9,000	234.35612	0.9	0.02344
8,000	208.31645	0.8	0.02083
7,000	182.27684	0.7	0.01823
6,000	156.23723	0.6	0.01562
5,000	130.19762	0.5	0.01302
4,000	104.15808	0.4	0.01042
3,000	78.11854	0.3	0.00781
2,000	52.07893	0.2	0.00521
1,000	26.03950	0.1	0.00260
900	23.43555	0.09	0.00234
800	20.83165	0.08	0.00208
700	18.22764	0.07	0.00182
600	15.62376	0.06	0.00156
500	13.01975	0.05	0.00130
400	10.41580	0.04	0.00104
300	7.81190	0.03	0.00078
200	5.20789	0.02	0.00052
100	2.60401	0.01	0.00026
90	2.34356	0.009	0.00023
80	2.08315	0.008	0.00021
70	1.82276	0.007	0.00018
60	1.56236	0.006	0.00016
50	1.30197	0.005	0.00013
40	1.04159	0.004	0.00010
30	0.78118	0.003	0.00008
20	0.52079	0.002	0.00005
10	0.26039	0.001	0.00003
9	0.23435	High tare nominal pressure, psi	
8	0.20831	30	
7	0.18227	M _a = 0.78118 lbs	
6	0.15623		
5	0.13019		
4	0.10416		
3	0.07812		
2	0.05208		
1	0.02604		

TABLE 4. - Corrected pressure, $\frac{M_a g_1/g_s}{A_o}$

Nominal pressure	Corrected pressure	Nominal pressure	Corrected pressure
12,000	11,983.6985	0.9	0.8989
11,000	10,985.0574	0.8	0.7988
10,000	9,986.4137	0.7	0.6991
9,000	8,987.7726	0.6	0.5990
8,000	7,989.1273	0.5	0.4993
7,000	6,990.4844	0.4	0.3996
6,000	5,991.8414	0.3	0.2995
5,000	4,993.1984	0.2	0.1998
4,000	3,994.5581	0.1	0.0997
3,000	2,995.9178	0.09	0.0897
2,000	1,997.2748	0.08	0.0798
1,000	998.6388	0.07	0.0698
900	898.7749	0.06	0.0598
800	798.9129	0.05	0.0499
700	699.0467	0.04	0.0399
600	599.1856	0.03	0.0299
500	499.3194	0.02	0.0199
400	399.4555	0.01	0.0100
300	299.5935		
200	199.7274		
100	99.8662		
90	89.8777		
80	79.8907		
70	69.9045		
60	59.9179		
50	49.9317		
40	39.9459		
30	29.9590		
20	19.9728		
10	9.9862		
9	8.9875		
8	7.9889		
7	6.9902		
6	5.9916		
5	4.9929		
4	3.9946		
3	2.9960		
2	1.9973		
1	0.9987		

High tare nominal pressure=30 psi
Corrected pressure = 29.9590 psi

TABLE 5. - Density of dry air, grams/liter

$t, ^\circ\text{C}$ P, mm	20	21	22	23	24	25	26	27	28	29	30
660	1.0463	1.0428	1.0392	1.0357	1.0322	1.0287	1.0253	1.0219	1.0184	1.0151	1.0117
661	1.0479	1.0443	1.0408	1.0373	1.0338	1.0303	1.0268	1.0234	1.0200	1.0166	1.0132
662	1.0495	1.0459	1.0424	1.0388	1.0353	1.0318	1.0284	1.0249	1.0215	1.0181	1.0148
663	1.0511	1.0475	1.0439	1.0404	1.0369	1.0334	1.0299	1.0265	1.0231	1.0197	1.0163
664	1.0527	1.0491	1.0455	1.0420	1.0384	1.0350	1.0315	1.0280	1.0246	1.0212	1.0178
665	1.0542	1.0506	1.0471	1.0435	1.0400	1.0365	1.0330	1.0296	1.0262	1.0228	1.0194
666	1.0558	1.0522	1.0486	1.0451	1.0416	1.0381	1.0346	1.0311	1.0277	1.0243	1.0209
667	1.0574	1.0538	1.0502	1.0467	1.0431	1.0396	1.0361	1.0327	1.0292	1.0258	1.0224
668	1.0590	1.0554	1.0518	1.0482	1.0447	1.0412	1.0377	1.0342	1.0308	1.0274	1.0240
669	1.0606	1.0570	1.0534	1.0498	1.0463	1.0427	1.0392	1.0358	1.0323	1.0289	1.0255
670	1.0622	1.0585	1.0549	1.0514	1.0478	1.0443	1.0408	1.0373	1.0339	1.0304	1.0270
671	1.0637	1.0601	1.0565	1.0529	1.0494	1.0459	1.0424	1.0389	1.0354	1.0320	1.0286
672	1.0653	1.0617	1.0581	1.0545	1.0509	1.0474	1.0439	1.0404	1.0370	1.0335	1.0301
673	1.0669	1.0633	1.0597	1.0561	1.0525	1.0490	1.0455	1.0420	1.0385	1.0350	1.0316
674	1.0685	1.0649	1.0612	1.0576	1.0541	1.0505	1.0470	1.0435	1.0400	1.0366	1.0332
675	1.0701	1.0664	1.0628	1.0592	1.0556	1.0521	1.0486	1.0451	1.0416	1.0381	1.0347
676	1.0717	1.0680	1.0644	1.0608	1.0572	1.0536	1.0501	1.0466	1.0431	1.0397	1.0362
677	1.0732	1.0696	1.0660	1.0623	1.0588	1.0552	1.0517	1.0482	1.0447	1.0412	1.0377
678	1.0748	1.0712	1.0675	1.0639	1.0603	1.0568	1.0532	1.0497	1.0462	1.0427	1.0393
679	1.0764	1.0727	1.0691	1.0655	1.0619	1.0583	1.0548	1.0512	1.0477	1.0443	1.0408
680	1.0780	1.0743	1.0707	1.0671	1.0635	1.0599	1.0563	1.0528	1.0493	1.0458	1.0423

TABLE 6. - Buoyancy correction factor for dry air, $(1 - \rho_a/\rho_b)$

$t, ^\circ\text{C}$ $P, \text{ mm}$	20	21	22	23	24	25
600	0.9998755	0.9998759	0.9998763	0.9998768	0.9998772	0.9998776
661	0.9998753	0.9998757	0.9998761	0.9998766	0.9998770	0.9998774
662	0.9998751	0.9998755	0.9998760	0.9998764	0.9998768	0.9998772
663	0.9998749	0.9998753	0.9998758	0.9998762	0.9998766	0.9998770
664	0.9998747	0.9998752	0.9998756	0.9998760	0.9998764	0.9998768
665	0.9998745	0.9998750	0.9998754	0.9998758	0.9998762	0.9998767
666	0.9998744	0.9998748	0.9998752	0.9998756	0.9998761	0.9998765
667	0.9998742	0.9998746	0.9998750	0.9998754	0.9998759	0.9998763
668	0.9998740	0.9998744	0.9998748	0.9998753	0.9998757	0.9998761
669	0.9998738	0.9998742	0.9998746	0.9998751	0.9998755	0.9998759
670	0.9998736	0.9998740	0.9998745	0.9998749	0.9998753	0.9998757
671	0.9998734	0.9998738	0.9998743	0.9998747	0.9998751	0.9998755
672	0.9998732	0.9998737	0.9998741	0.9998745	0.9998749	0.9998754
673	0.9998730	0.9998735	0.9998739	0.9998743	0.9998748	0.9998752
674	0.9998728	0.9998733	0.9998737	0.9998741	0.9998746	0.9998750
675	0.9998727	0.9998731	0.9998735	0.9998740	0.9998744	0.9998748
676	0.9998725	0.9998729	0.9998733	0.9998738	0.9998742	0.9998746
677	0.9998723	0.9998727	0.9998732	0.9998736	0.9998740	0.9998744
678	0.9998721	0.9998725	0.9998730	0.9998734	0.9998738	0.9998742
679	0.9998719	0.9998723	0.9998728	0.9998732	0.9998736	0.9998741
680	0.9998717	0.9998722	0.9998726	0.9998730	0.9998734	0.9998739

TABLE 6. - Buoyancy correction factor for dry air, $(1 - \rho_a/\rho_b)$ (Con)

$t, ^\circ\text{C}$ $P, \text{ mm}$	26	27	28	29	30
660	0.9998780	0.9998784	0.9998788	0.9998792	0.9998796
661	0.9998778	0.9998782	0.9998786	0.9998790	0.9998794
662	0.9998776	0.9998780	0.9998784	0.9998788	0.9998792
663	0.9998774	0.9998778	0.9998783	0.9998787	0.9998791
664	0.9998773	0.9998777	0.9998781	0.9998785	0.9998789
665	0.9998771	0.9998775	0.9998779	0.9998783	0.9998787
666	0.9998769	0.9998773	0.9998777	0.9998781	0.9998785
667	0.9998767	0.9998771	0.9998775	0.9998779	0.9998783
668	0.9998765	0.9998769	0.9998773	0.9998777	0.9998781
669	0.9998763	0.9998767	0.9998772	0.9998776	0.9998780
670	0.9998761	0.9998766	0.9998770	0.9998774	0.9998778
671	0.9998760	0.9998764	0.9998768	0.9998772	0.9998776
672	0.9998758	0.9998762	0.9998766	0.9998770	0.9998774
673	0.9998756	0.9998760	0.9998764	0.9998768	0.9998772
674	0.9998754	0.9998758	0.9998762	0.9998766	0.9998771
675	0.9998752	0.9998756	0.9998761	0.9998765	0.9998769
676	0.9998750	0.9998755	0.9998759	0.9998763	0.9998767
677	0.9998749	0.9998753	0.9998757	0.9998761	0.9998765
678	0.9998747	0.9998751	0.9998755	0.9998759	0.9998763
679	0.9998745	0.9998749	0.9998753	0.9998757	0.9998761
680	0.9998743	0.9998747	0.9998751	0.9998755	0.9998760

TABLE 7.-Pressure distortion correction factor for piston gage

No. 9274, $\frac{1}{1 + bP}$

P, psi	$\frac{1}{1 + bP}$	P, psi	$\frac{1}{1 + bP}$	P, psi	$\frac{1}{1 + bP}$
12,100	1.0004235				
12,000	1.0004200				
11,900	1.0004165	8,900	1.0003115	5,900	1.0002065
11,800	1.0004130	8,800	1.0003080	5,800	1.0002030
11,700	1.0004095	8,700	1.0003045	5,700	1.0001995
11,600	1.0004060	8,600	1.0003010	5,600	1.0001960
11,500	1.0004025	8,500	1.0002975	5,500	1.0001925
11,400	1.0003990	8,400	1.0002940	5,400	1.0001890
11,300	1.0003955	8,300	1.0002905	5,300	1.0001855
11,200	1.0003920	8,200	1.0002870	5,200	1.0001820
11,100	1.0003885	8,100	1.0002835	5,100	1.0001785
11,000	1.0003850	8,000	1.0002800	5,000	1.0001750
10,900	1.0003815	7,900	1.0002765	4,900	1.0001715
10,800	1.0003780	7,800	1.0002730	4,800	1.0001680
10,700	1.0003745	7,700	1.0002695	4,700	1.0001645
10,600	1.0003710	7,600	1.0002660	4,600	1.0001610
10,500	1.0003675	7,500	1.0002625	4,500	1.0001575
10,400	1.0003640	7,400	1.0002590	4,400	1.0001540
10,300	1.0003605	7,300	1.0002555	4,300	1.0001505
10,200	1.0003570	7,200	1.0002520	4,200	1.0001470
10,100	1.0003535	7,100	1.0002485	4,100	1.0001435
10,000	1.0003500	7,000	1.0002450	4,000	1.0001400
9,900	1.0003465	6,900	1.0002415	3,900	1.0001365
9,800	1.0003430	6,800	1.0002380	3,800	1.0001330
9,700	1.0003395	6,700	1.0002345	3,700	1.0001295
9,600	1.0003360	6,600	1.0002310	3,600	1.0001260
9,500	1.0003325	6,500	1.0002275	3,500	1.0001225
9,400	1.0003290	6,400	1.0002240	3,400	1.0001190
9,300	1.0003255	6,300	1.0002205	3,300	1.0001155
9,200	1.0003220	6,200	1.0002170	3,200	1.0001120
9,100	1.0003185	6,100	1.0002135	3,100	1.0001085
9,000	1.0003150	6,000	1.0002100	3,000	1.0001050

TABLE 7.-Pressure distortion correction factor for piston gage

No. 9274, $\frac{1}{1 + bP}$			
P, psi	$\frac{1}{1 + bP}$	$t, ^\circ C$	$\frac{1}{1 + c(t - 25)}$
2,900	1.0001015	24.0	1.0000130
2,800	1.0000980	24.1	1.0000133
2,700	1.0000945	24.2	1.0000136
2,600	1.0000910	24.3	1.0000139
2,500	1.0000875	24.4	1.0000142
2,400	1.0000840	24.5	1.0000145
2,300	1.0000805	24.6	1.0000148
2,200	1.0000770	24.7	1.0000151
2,100	1.0000735	24.8	1.0000154
2,000	1.0000700	24.9	1.0000157
1,900	1.0000665	25.0	1.0000160
1,800	1.0000630	25.1	0.9999953
1,700	1.0000595	25.2	0.9999956
1,600	1.0000560	25.3	0.9999959
1,500	1.0000525	25.4	0.9999962
1,400	1.0000490	25.5	0.9999965
1,300	1.0000455	25.6	0.9999968
1,200	1.0000420	25.7	0.9999971
1,100	1.0000385	25.8	0.9999974
1,000	1.0000350	25.9	0.9999977
900	1.0000315	26.0	0.9999980
800	1.0000280	26.1	0.9999983
700	1.0000245	26.2	0.9999986
600	1.0000210	26.3	0.9999989
500	1.0000175	26.4	0.9999992
400	1.0000140	26.5	0.9999995
300	1.0000105	26.6	0.9999998
200	1.0000070	26.7	0.9999999
100	1.0000035	26.8	0.9999999
90	1.0000032	26.9	0.9999999
80	1.0000028	27.0	0.9999999
70	1.0000025	27.1	0.9999999
60	1.0000021	27.2	0.9999999
50	1.0000018	27.3	0.9999999
40	1.0000014	27.4	0.9999999
30	1.0000011	27.5	0.9999999
20	1.0000007	27.6	0.9999999
10	1.0000004	27.7	0.9999999
		27.8	0.9999999
		27.9	0.9999999

TABLE 8. - Temperature correction factor for piston gage No. 9274,

$\frac{1}{1 + c(t - 25)}$			
t, °C	$\frac{1}{1 + c(t - 25)}$	t, °C	$\frac{1}{1 + c(t - 25)}$
20.0	1.0000850	24.0	1.0000170
20.1	1.0000833	24.1	1.0000153
20.2	1.0000816	24.2	1.0000136
20.3	1.0000799	24.3	1.0000119
20.4	1.0000782	24.4	1.0000102
20.5	1.0000765	24.5	1.0000085
20.6	1.0000748	24.6	1.0000068
20.7	1.0000731	24.7	1.0000051
20.8	1.0000714	24.8	1.0000034
20.9	1.0000697	24.9	1.0000017
21.0	1.0000680	25.0	1.0000000
21.1	1.0000663	25.1	0.9999983
21.2	1.0000646	25.2	0.9999966
21.3	1.0000629	25.3	0.9999949
21.4	1.0000612	25.4	0.9999932
21.5	1.0000595	25.5	0.9999915
21.6	1.0000578	25.6	0.9999898
21.7	1.0000561	25.7	0.9999881
21.8	1.0000544	25.8	0.9999864
21.9	1.0000527	25.9	0.9999847
22.0	1.0000510	26.0	0.9999830
22.1	1.0000493	26.1	0.9999813
22.2	1.0000476	26.2	0.9999796
22.3	1.0000459	26.3	0.9999779
22.4	1.0000442	26.4	0.9999762
22.5	1.0000425	26.5	0.9999745
22.6	1.0000408	26.6	0.9999728
22.7	1.0000391	26.7	0.9999711
22.8	1.0000374	26.8	0.9999694
22.9	1.0000357	26.9	0.9999677
23.0	1.0000340	27.0	0.9999660
23.1	1.0000323	27.1	0.9999643
23.2	1.0000306	27.2	0.9999626
23.3	1.0000289	27.3	0.9999609
23.4	1.0000272	27.4	0.9999592
23.5	1.0000255	27.5	0.9999575
23.6	1.0000238	27.6	0.9999558
23.7	1.0000221	27.7	0.9999541
23.8	1.0000204	27.8	0.9999524
23.9	1.0000187	27.9	0.9999507

TABLE 8. - Temperature correction factor for piston gage No. 9274,

$\frac{1}{1 + c(t - 25)}$ (Con)					
t, °C	$\frac{1}{1 + c(t - 25)}$				
28.0	0.9999490				
28.1	0.9999473				
28.2	0.9999456				
28.3	0.9999439				
28.4	0.9999422				
28.5	0.9999405				
28.6	0.9999388				
28.7	0.9999371				
28.8	0.9999354				
28.9	0.9999337				
29.0	0.9999320				
29.1	0.9999303				
29.2	0.9999286				
29.3	0.9999269				
29.4	0.9999252				
29.5	0.9999235				
29.6	0.9999218				
29.7	0.9999201				
29.8	0.9999184				
29.9	0.9999167				
30.0	0.9999150				
2.900	0.0183	3.900	0.0109	1.900	0.0035
2.800	0.0184	3.800	0.0107	1.800	0.0035
2.700	0.0185	3.700	0.0105	1.700	0.0035
2.600	0.0186	3.600	0.0104	1.600	0.0035
2.500	0.0187	3.500	0.0103	1.500	0.0035
2.400	0.0188	3.400	0.0102	1.400	0.0035
2.300	0.0189	3.300	0.0101	1.300	0.0035
2.200	0.0190	3.200	0.0100	1.200	0.0035
2.100	0.0191	3.100	0.0099	1.100	0.0035
2.000	0.0192	3.000	0.0098	1.000	0.0035
1.900	0.0193	2.900	0.0097	0.900	0.0035
1.800	0.0194	2.800	0.0096	0.800	0.0035
1.700	0.0195	2.700	0.0095	0.700	0.0035
1.600	0.0196	2.600	0.0094	0.600	0.0035
1.500	0.0197	2.500	0.0093	0.500	0.0035
1.400	0.0198	2.400	0.0092	0.400	0.0035
1.300	0.0199	2.300	0.0091	0.300	0.0035
1.200	0.0200	2.200	0.0090	0.200	0.0035
1.100	0.0201	2.100	0.0089	0.100	0.0035
1.000	0.0202	2.000	0.0088	0.000	0.0035
0.900	0.0203	1.900	0.0087		
0.800	0.0204	1.800	0.0086		
0.700	0.0205	1.700	0.0085		
0.600	0.0206	1.600	0.0084		
0.500	0.0207	1.500	0.0083		
0.400	0.0208	1.400	0.0082		
0.300	0.0209	1.300	0.0081		
0.200	0.0210	1.200	0.0080		
0.100	0.0211	1.100	0.0079		
0.000	0.0212	1.000	0.0078		

TABLE 9. - Correction to be added to gage pressure to correct for zero shift of differential pressure cell No. 9032

P, psi	ΔP , psi	P, psi	ΔP , psi	P, psi	ΔP , psi
12,100	0.0224				
12,000	0.0222				
11,900	0.0220	7,900	0.0146	3,900	0.0072
11,800	0.0218	7,800	0.0144	3,800	0.0070
11,700	0.0216	7,700	0.0142	3,700	0.0068
11,600	0.0215	7,600	0.0141	4,600	0.0067
11,500	0.0213	7,500	0.0139	3,500	0.0065
11,400	0.0211	7,400	0.0137	3,400	0.0063
11,300	0.0209	7,300	0.0135	3,300	0.0061
11,200	0.0207	7,200	0.0133	3,200	0.0059
11,100	0.0205	7,100	0.0131	3,100	0.0057
11,000	0.0204	7,000	0.0130	3,000	0.0056
10,900	0.0202	6,900	0.0128	2,900	0.0054
10,800	0.0200	6,800	0.0126	2,800	0.0052
10,700	0.0198	6,700	0.0124	2,700	0.0050
10,600	0.0196	6,600	0.0122	2,600	0.0048
10,500	0.0194	6,500	0.0120	2,500	0.0046
10,400	0.0192	6,400	0.0118	2,400	0.0044
10,300	0.0191	6,300	0.0117	2,300	0.0043
10,200	0.0189	6,200	0.0115	2,200	0.0041
10,100	0.0187	6,100	0.0113	2,100	0.0039
10,000	0.0185	6,000	0.0111	2,000	0.0037
9,900	0.0183	5,900	0.0109	1,900	0.0035
9,800	0.0181	5,800	0.0107	1,800	0.0033
9,700	0.0179	5,700	0.0105	1,700	0.0031
9,600	0.0178	5,600	0.0104	1,600	0.0030
9,500	0.0176	5,500	0.0102	1,500	0.0028
9,400	0.0174	5,400	0.0100	1,400	0.0026
9,300	0.0172	5,300	0.0098	1,300	0.0024
9,200	0.0170	5,200	0.0096	1,200	0.0022
9,100	0.0168	5,100	0.0094	1,100	0.0020
9,000	0.0167	5,000	0.0093	1,000	0.0019
8,900	0.0165	4,900	0.0091	900	0.0017
8,800	0.0163	4,800	0.0089	800	0.0015
8,700	0.0161	4,700	0.0087	700	0.0013
8,600	0.0159	4,600	0.0085	600	0.0011
8,500	0.0157	4,500	0.0083	500	0.0009
8,400	0.0155	4,400	0.0081	400	0.0007
8,300	0.0154	4,300	0.0080	300	0.0006
8,200	0.0152	4,200	0.0078	200	0.0004
8,100	0.0150	4,100	0.0076	100	0.0002
8,000	0.0148	4,000	0.0074		

